Cell Phones and Risk of Brain Tumor

INTERPHONE Study 2010

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doi:10.1093/ije/dyq079

THEME: CANCER

Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case–control study

The INTERPHONE Study Group*

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*List of members of this study group is available in the Appendix.

Accepted 8 March 2010

Background The rapid increase in mobile telephone use has generated concern about possible health risks related to radiofrequency electromagnetic fields from this technology.

Methods An interview-based case–control study with 2708 glioma and 2409 meningioma cases and matched controls was conducted in 13 countries using a common protocol.

Large case-control study at multiple centers.

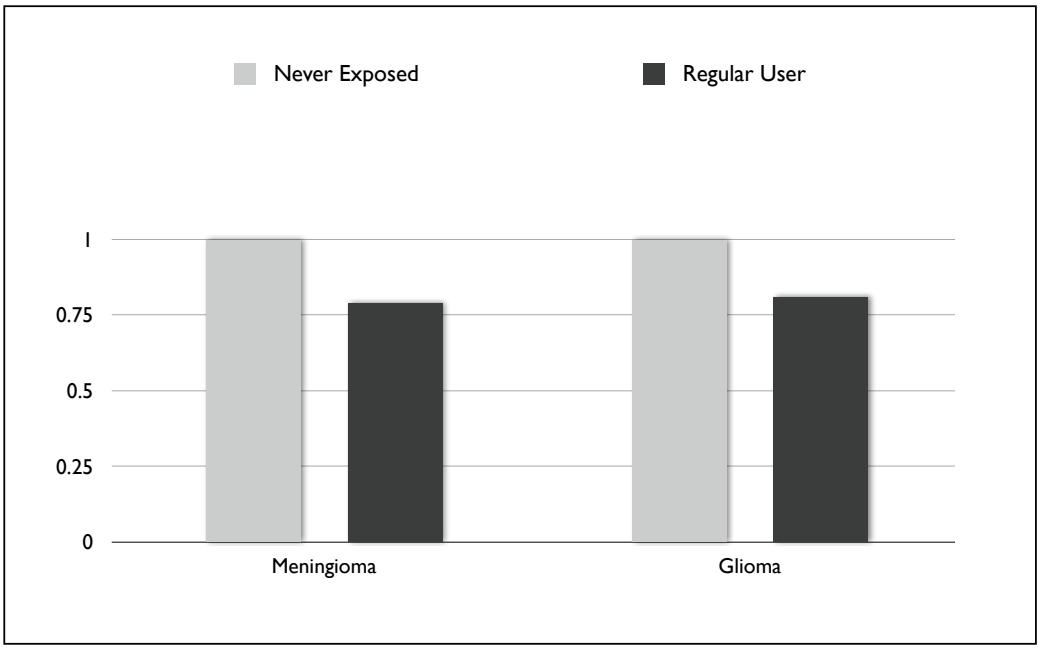
Funded in significant part by the telecommunications industry.

INTERPHONE Study 2010

Conclusions Overall, no increase in risk of glioma or meningioma was observed with use of mobile phones.

From the authors' published conclusions.

Odds Ratio for Meningioma and Glioma



In the 2010 Interphone Study combined analysis of data for all levels of exposure found that "regular cell phone users" were less likely to have brain tumors than non-users.

This is what was reported in the media about this study.

A reduced odds ratio (OR) related to ever having been a regular mobile phone user was seen for glioma [OR 0.81; 95% confidence interval (CI) 0.70–0.94] and meningioma (OR 0.79; 95% CI 0.68–0.91)

INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.

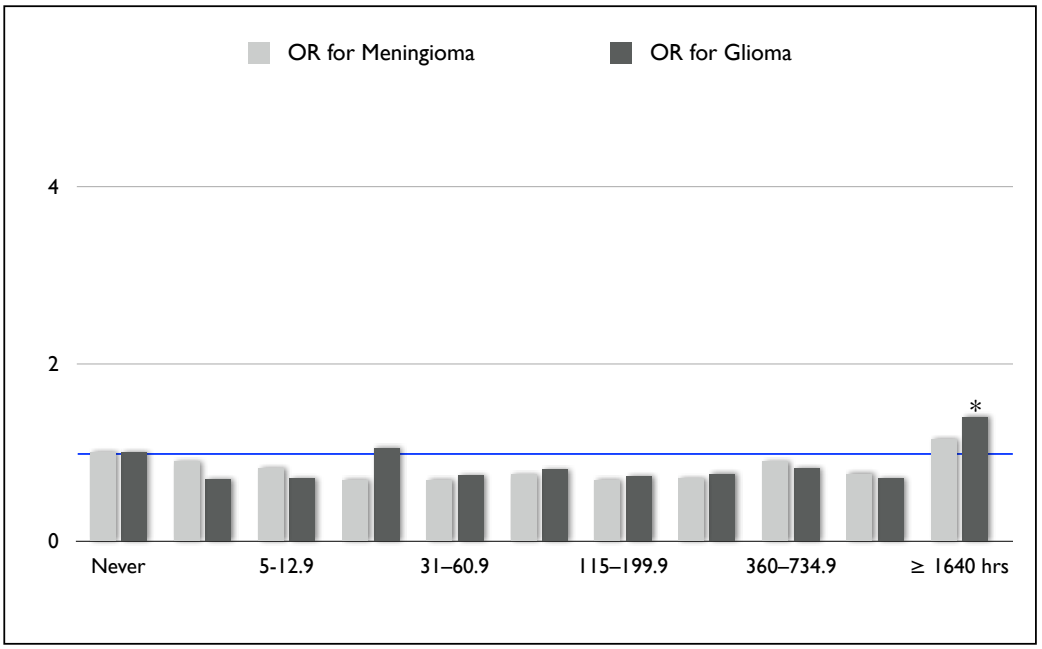
INTERPHONE Study 2010 – Definition of "Risk"

if the subject had ever been a regular user of a mobile phone (had an average of at least one call per week for a period of ⩾6 months).[26]

However, "regular use" was defined as a minimum of one call for week for at least 6 months.

In otherwords, anyone who had made at least 26 cell phone calls in their lifetime was categorized as a "regular user" and placed in the risk group.

Odds Ratio for Meningioma and Glioma with Cell Phone Use



Cumulative call time without hands-free devices, **divided into deciles**.

Blue line is Odds Ratio of 1.0 (equal to control group).

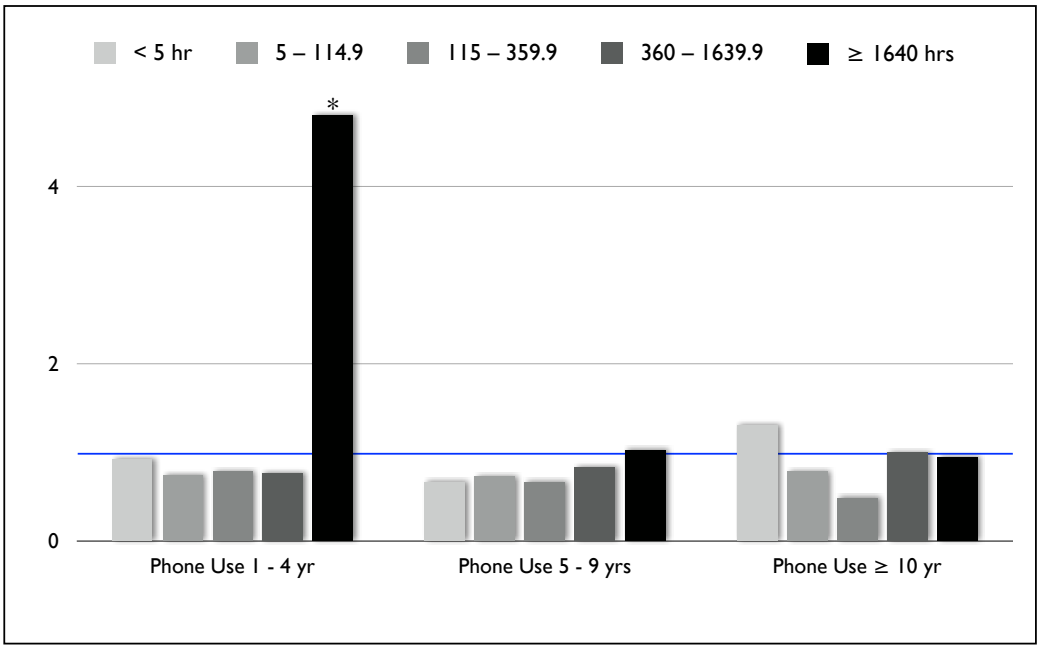
Half of the subjects in the study had less than 115 hours of lifetime exposure.

Note that a significantly higher risk for glioma was seen with more than 1640 hours of exposure.

OR for glioma = 1.40 [95% CI = (1.03–1.89)]

From Table 2: INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.

Odds Ratio for Meningioma with Cell Phone Use



Charted data from the Interphone study for risk of meningioma.

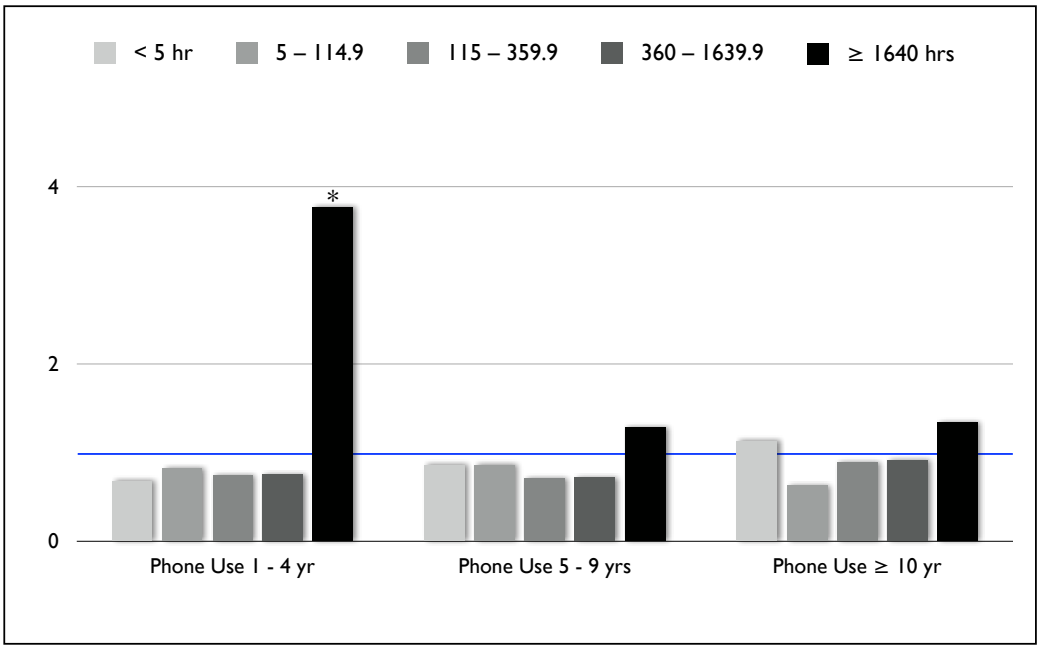
With ≥1640 hrs exposure in 1 – 4 years, OR = 4.80 [95% CI = (1.49–15.4)]

1640 hours in 4 years = 7.9 hrs/wk

(range in cohort was 8 – 30 hrs/wk, which the authors discounted as "implausable values of use" in their summary of results)

From Table 3: INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.

Odds Ratio for Glioma with Cell Phone Use



Charted data from INTERPHONE study group, glioma risk.

Stratified by cumulative call time (without hands/free devices).

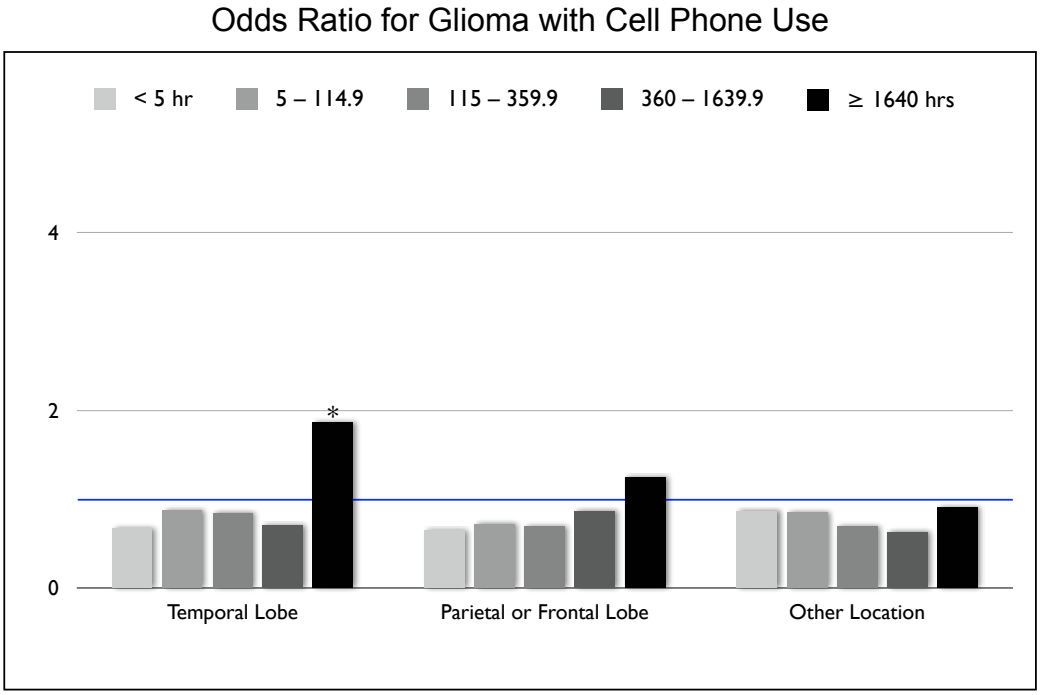
Also stratified by years of use.

With ≥1640 hrs exposure in 1 – 4 years, OR for Glioma = 3.77 [95% CI = (1.25–11.4)]

1640 hours in 4 years = 7.9 hrs/wk (range in cohort was 8 – 30 hrs/wk)

The authors rejected their own findings on glioma, stating that this level of reported cell phone use was "implausable".

From Table 3: INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.



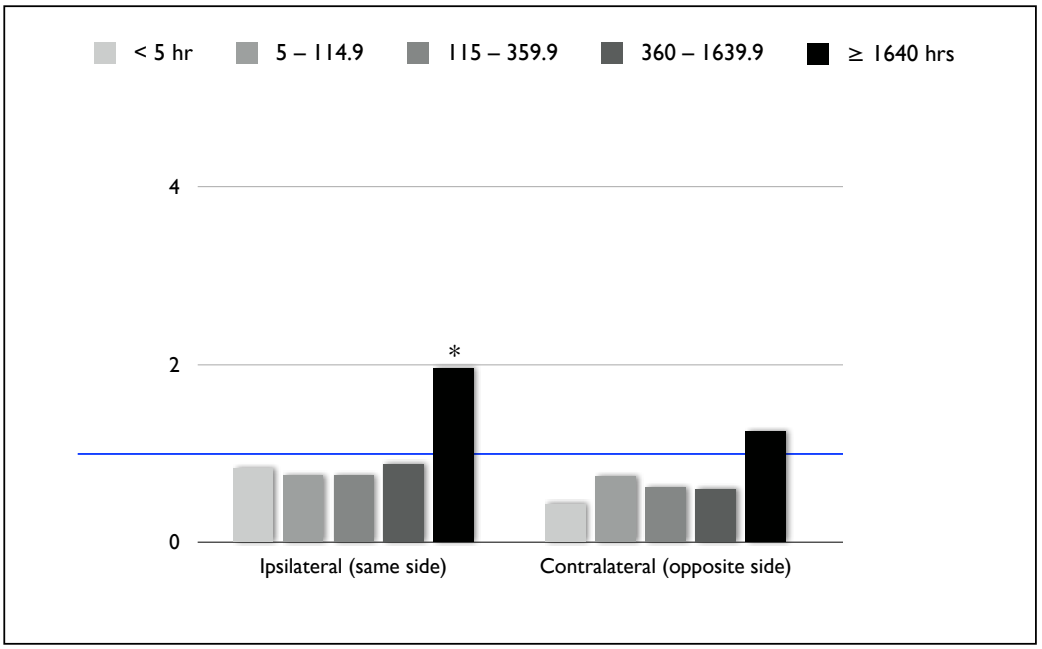
Glioma risk by **location in the brain**.

Also stratified by **cumulative call time**.

Temporal lobe (With ≥1640 hrs exposure, OR = 1.87 [95% CI = (1.09–3.22)]

From Table 4: INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.

Interestingly, the study did report its statistics stratified by total time of reported use, and the top decile (greater than 1640 hours use over a ten year interval, averaging out as greater than 3 hours a week) had an increased risk of certain tumors. Individuals who accrued that greater than 1650 hours of use over a 1 to 4 year interval (ranging from 8 to over 30 hours a week) had a markedly higher odds ratio of meningioma (OR 4.80) or glioma (OR 3.27).



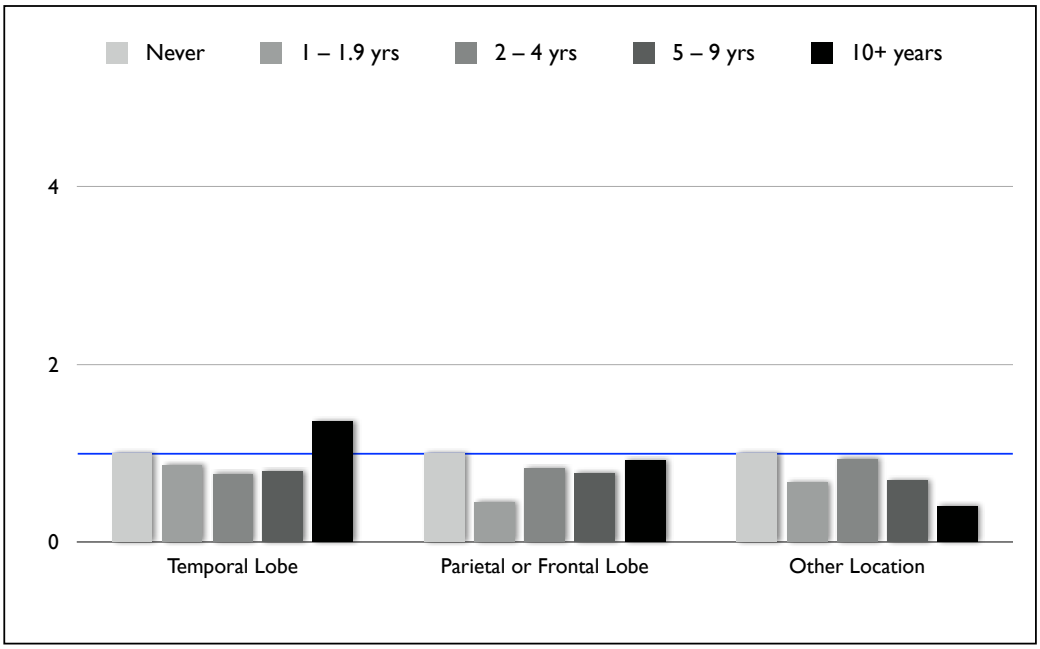
Glioma risk by **side of head they habitually held the phone**.

Also stratified by **cumulative call time**.

(With ≥1640 hrs exposure, Ipsilateral OR = 1.96 [95% CI = (1.22–3.22)]

From Table 5: INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.

Odds Ratio for Glioma (by Years of Use)

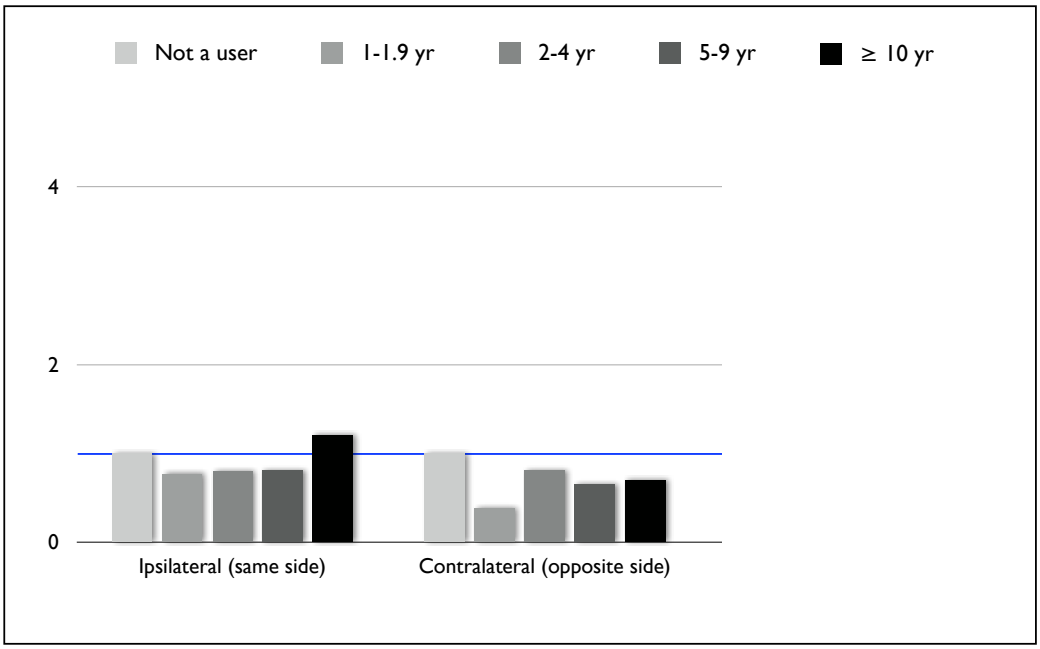


Stratified by **years of exposure**.

1640 hours in 10+ years ~ > 3 hrs/wk
1640 hours in 4 years = 7.9 hrs/wk (range in cohort was 8 – 30 hrs/wk)

INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.

Odds Ratio for Glioma (by Years of Use)



Glioma risk by **side of head they habitually held the phone**.
Also stratified by **cumulative call time**.

1640 hours in 10+ years ~ > 3 hrs/wk

INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Int J Epidemiol* (2010); 39(3):675-694.

INTERPHONE Study 2011

Acoustic neuroma risk in relation to mobile telephone use: Results of the INTERPHONE international case–control study

The INTERPHONE Study Group[*,1]

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ABSTRACT

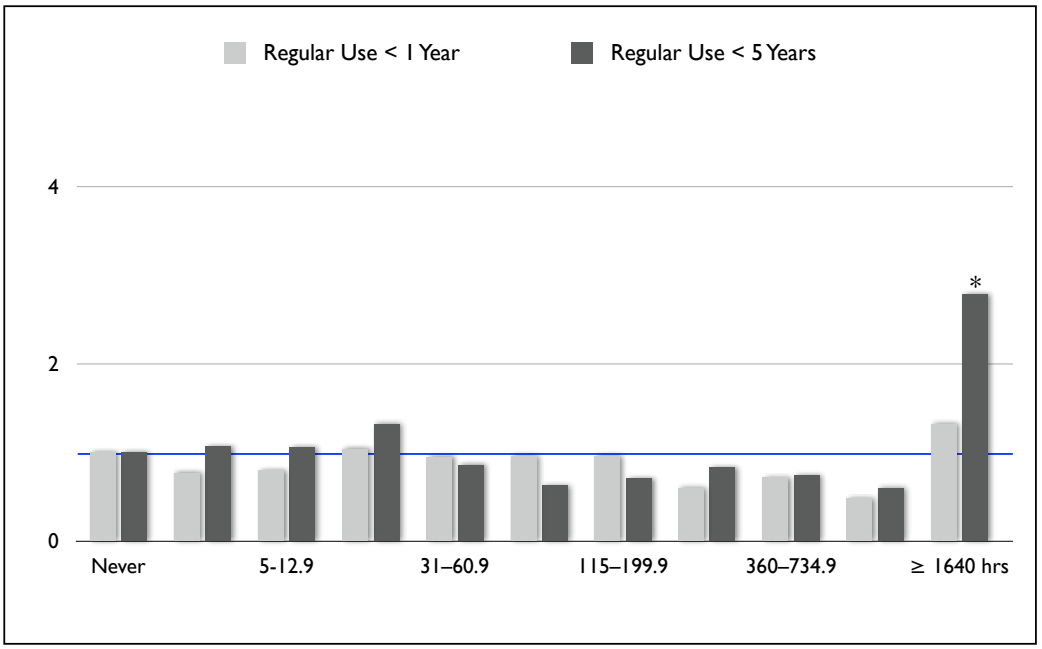
Background: The rapid increase in mobile telephone use has generated concern about possible health risks of radiofrequency electromagnetic fields from these devices. *Methods:* A case–control study of 1105 patients with newly diagnosed acoustic neuroma (vestibular schwannoma) and 2145 controls was conducted in 13 countries using a common protocol. Past mobile phone use was assessed by personal interview. In the primary analysis, exposure time was censored at one year before the reference date (date of diagnosis for cases and date of diagnosis of the matched case for controls); analyses censoring exposure at five years before the reference date were also done to allow for a possible longer latent period. *Results:* The odds ratio (OR) of acoustic neuroma with ever having been a regular mobile phone user was 0.85 (95% confidence interval 0.69–1.04). The OR for >10 years after first regular mobile phone use was 0.76 (0.52–1.11). There was no trend of increasing ORs with increasing cumulative call time or cumulative number of calls, with the lowest OR (0.48 (0.30–0.78)) observed in the 9th decile of cumulative call time. In the 10th decile (≥1640 h) of cumulative call time, the OR was 1.32 (0.88–1.97); there were, however, implausible values of reported use in those with ≥1640 h of accumulated mobile phone use. With censoring at 5 years before the reference date the OR for >10 years after first regular mobile phone use was 0.83 (0.58–1.19) and for >1640 h of cumulative call time it was 2.79 (1.51–5.16), but again with no trend in the lower nine deciles and with the lowest OR in the 9th decile. In general, ORs were not greater in subjects who reported usual phone use on the same side of the head as their tumour than in those who reported it on the opposite side, but it was greater in those in the 10th decile of cumulative hours of use. *Conclusions:* There was no increase in risk of acoustic neuroma with ever regular use of a mobile phone or for users who began regular use 10 years or more before the reference date. Elevated odds ratios observed at the highest level of cumulative call time could be due to chance, reporting bias or a causal effect. As acoustic neuroma is usually a slowly growing tumour, the interval between introduction of mobile phones and occurrence of the tumour might have been too short to observe an effect, if there is one.

2011 INTERPHONE study of acoustic neuroma

Funded in significant part by the telecommunications industry.

Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

Odds Ratio for Acoustic Neuroma with Cell Phone Use



From 2011 INTERPHONE study of acoustic neuroma, Table 2.

This study was also funded in major part by the telecommunications industry.

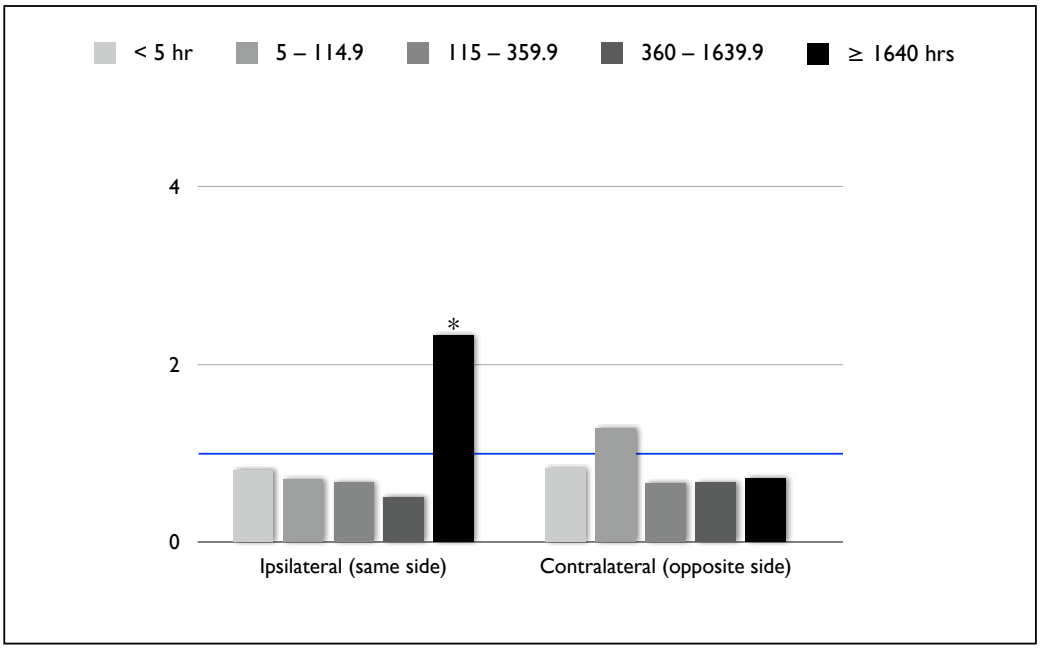
In their conclusion, the authors stated that this data showed **"no trend of increasing risk with increasing cumulative call time"**

They discounted their findings for the highest decile of exposure.

But with ≥1640 hrs exposure in 1 – 5 years of exposure, **OR = 2.79 [95% CI = (1.51–5.16)]**

From Table 2: Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

Acoustic Neuroma Risk (< 1 year of cell phone use)



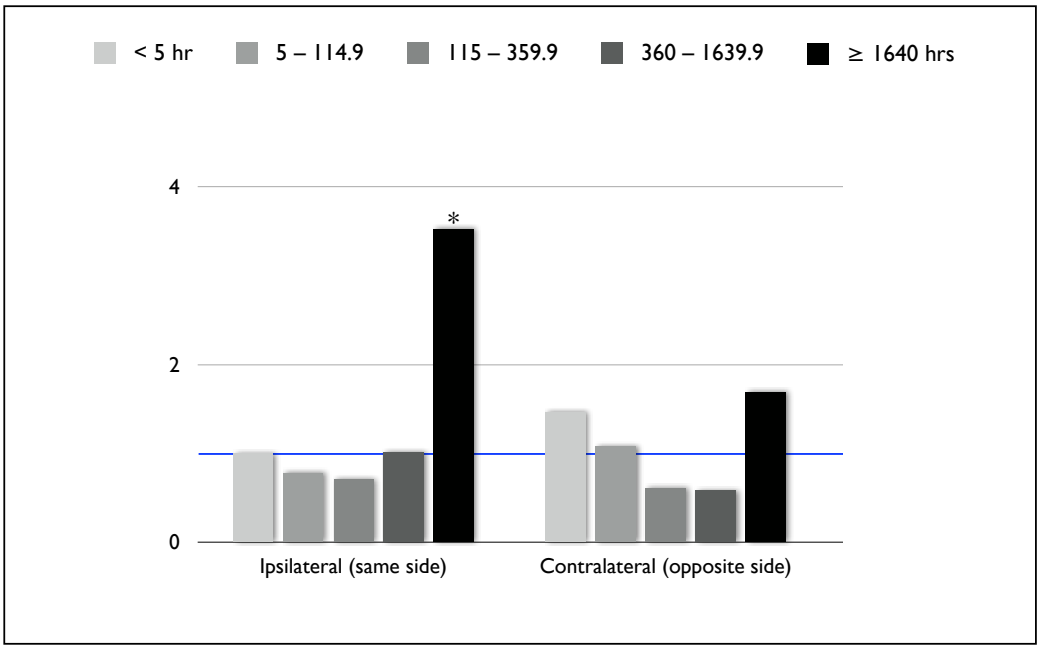
In the high use group, risk of acoustic neuroma was significantly higher on the side of the head where the subject habitually held the cell phone.

1640 hours in 1 year = 4.5 hours a day = 31.5 hours/week

With ≥1640 hrs exposure, ipsilateral tumor Odds Ratio = 2.33 [95% CI = (1.23–4.40)]

From Table 3: Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

Acoustic Neuroma Risk (< 5 years of cell phone use)



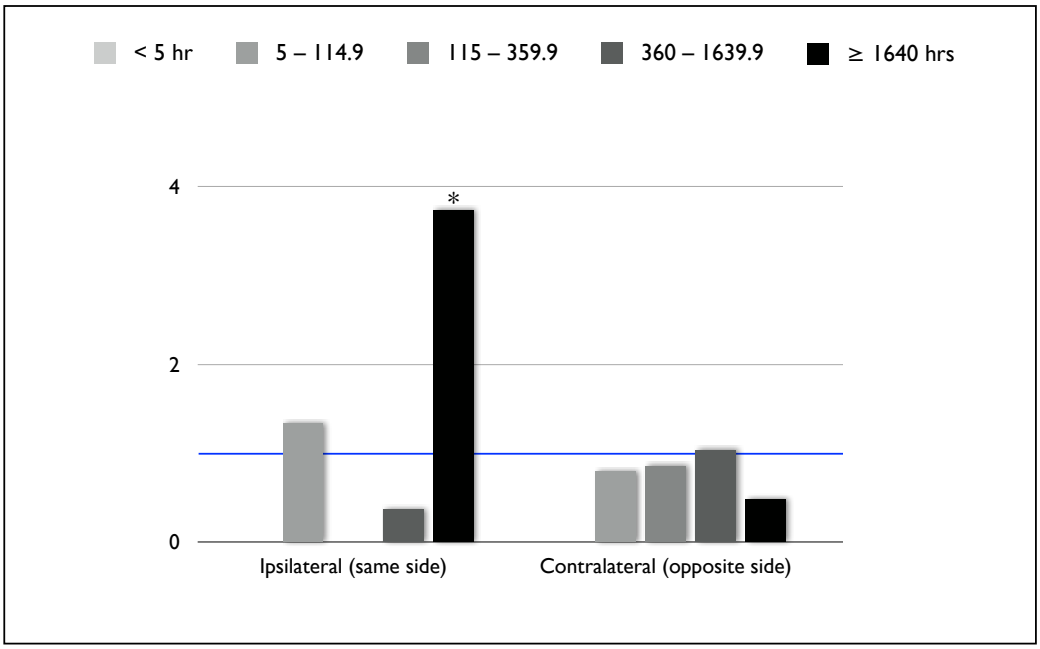
Risk increased with increased years of exposure.

1640 hours in 5 years = 0.9 hours a day = 6.3 hours/week

With ≥1640 hrs exposure, ipsilateral tumor Odds Ratio = 3.53 [95% CI = (1.59–7.82)]

From Table 3: Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

Acoustic Neuroma Risk (≥ 10 years of cell phone use)



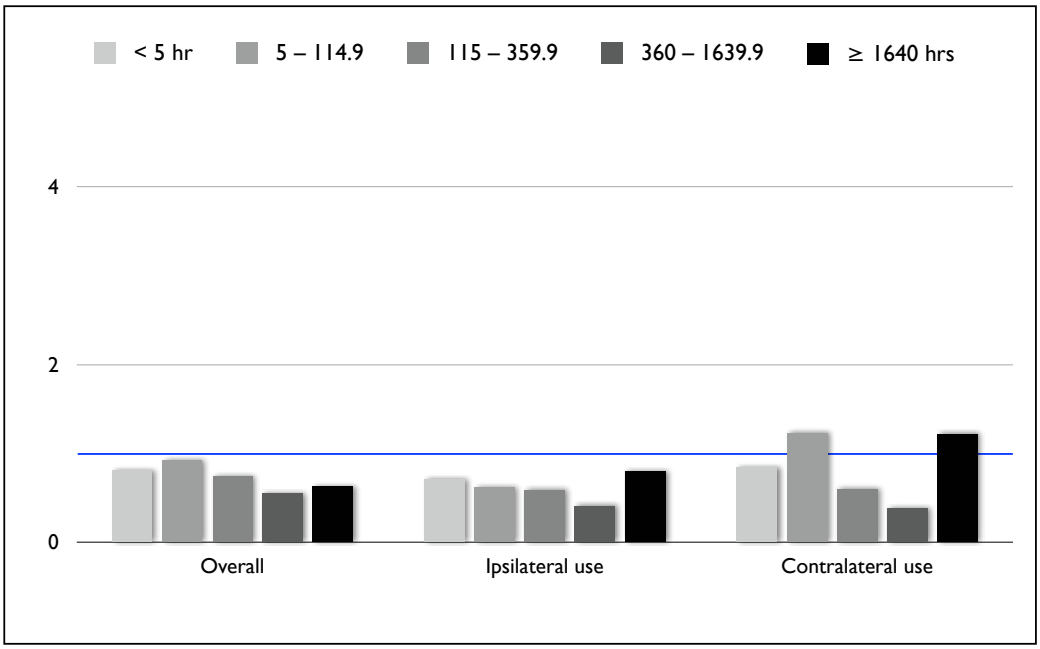
Higher risk with ten or more years of exposure.

1640 hours in 10 years = less than half an hour a day. = 3.2 hours/week = 0.45 hours a day

With ≥1640 hrs exposure, ipsilateral tumor Odds Ratio = 3.74 [95% CI = (1.58–8.83)]

From Table 4: Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

Acoustic Neuroma Risk with 1 to 4 Years of Cell Phone Use

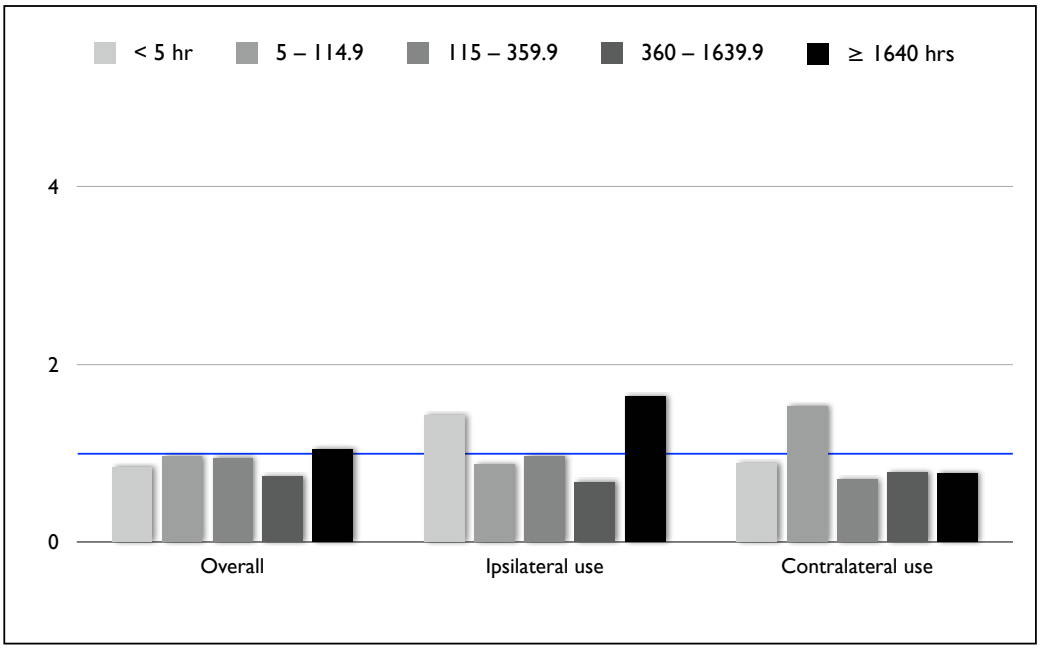


2011 INTERPHONE study of acoustic neuroma

From Table 4: Short, medium, long-term accumulation of >1640 hours.

Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

Acoustic Neuroma Risk with 5 to 9 Years of Cell Phone Use

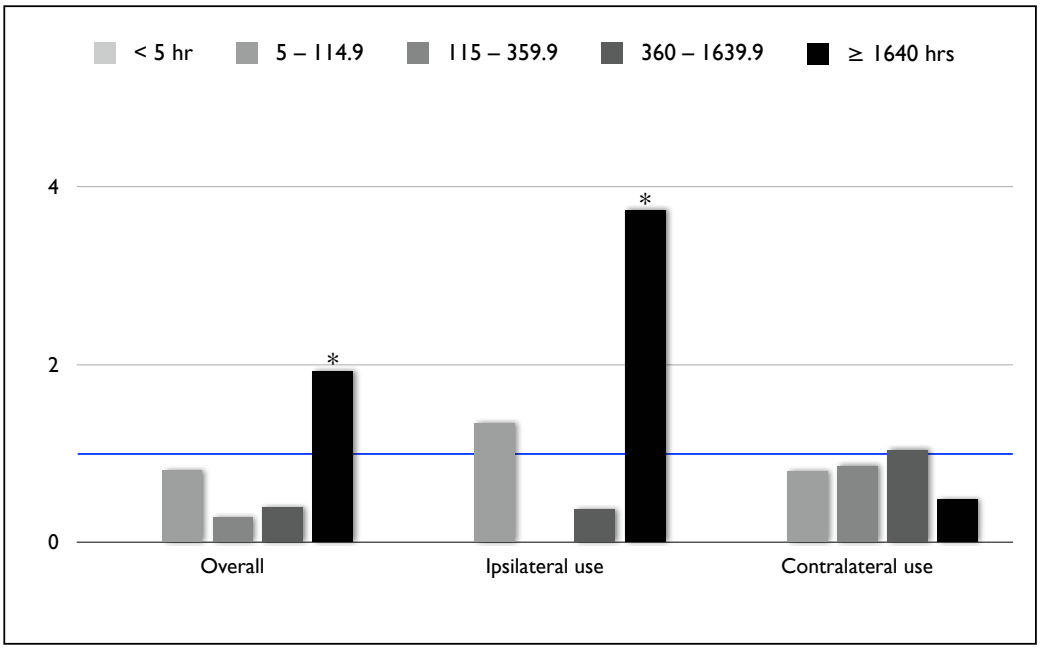


2011 INTERPHONE study of acoustic neuroma

From Table 4: Short, medium, long-term accumulation of >1640 hours.

Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

Acoustic Neuroma Risk with 10 + Years of Cell Phone Use



2011 INTERPHONE study of acoustic neuroma

From Table 4: Short, medium, long-term accumulation of ≥1640 hours.

Cardis E, Schüz J. Acoustic neuroma risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *Cancer Epidemiol* (2011); 35(5):453-464.

INTERPHONE Study 2011

PRESS RELEASE

Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries

E Cardis,[1] B K Armstrong,[2] J D Bowman,[3] G G Giles,[4,5] M Hours,[6] D Krewski,[7] M McBride,[8] M E Parent,[9] S Sadetzki,[10,11] A Woodward,[12] J Brown,[2] A Chetrit,[10] J Figuerola,[1] C Hoffmann,[11,13] A Jarus-Hakak,[10] L Montestruq,[6] L Nadon,[9] L Richardson,[14] R Villegas,[1] M Vrijheid[1]

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9 June 2011

ABSTRACT
Objectives The objective of this study was to examine the associations of brain tumours with radio frequency (RF) fields from mobile phones.
Methods Patients with brain tumour from the Australian, Canadian, French, Israeli and New Zealand components of the Interphone Study, whose tumours were localised by neuroradiologists, were analysed. Controls were matched on age, sex and region and allocated the 'tumour location' of their matched case. Analyses included 553 glioma and 676 meningioma cases and 1762 and 1911 controls, respectively. RF dose was estimated as total cumulative specific energy (TCSE; J/kg) absorbed at the tumour's estimated centre taking into account multiple RF exposure determinants.
Results ORs with ever having been a regular mobile phone user were 0.93 (95% CI 0.73 to 1.18) for glioma and 0.80 (95% CI 0.66 to 0.96) for meningioma. ORs for glioma were below 1 in the first four quintiles of TCSE

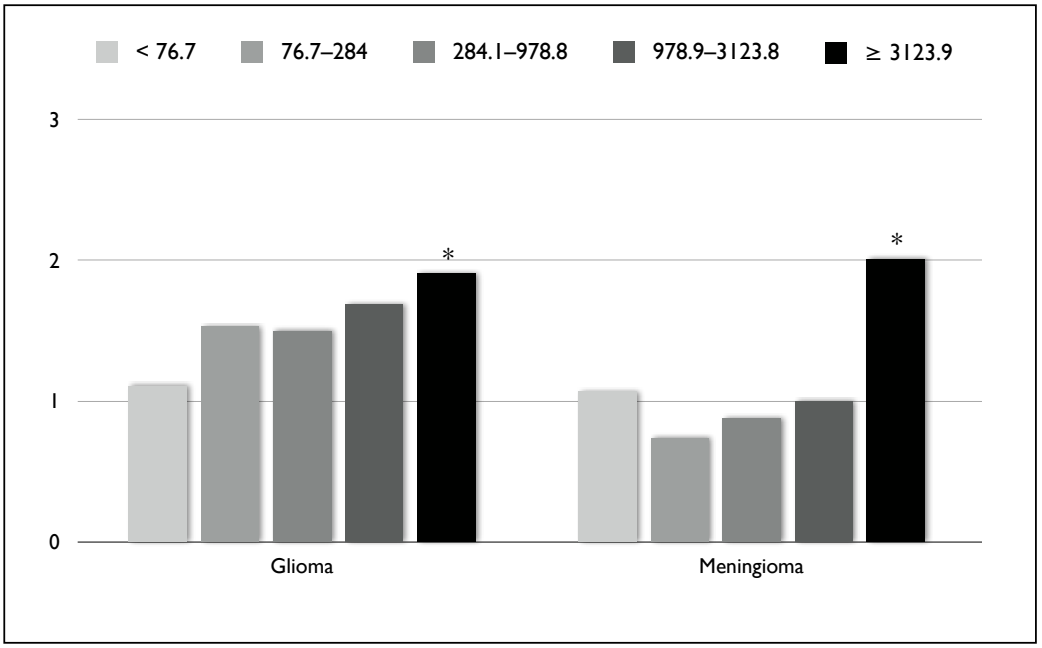
What this paper adds

- Previous epidemiological studies of mobile phone use and brain cancer risk have used information on mobile phone use as a proxy measure of exposure to radio frequency fields from mobile phones.
- Most studies have not observed increased ORs in relation to ever having been a mobile phone user. There were suggestions, however, of an increased risk of glioma in long-term and heavy users, though biases and errors prevent a causal interpretation.
- The relationship between radio frequency energy absorbed at the tumour location and mobile phone use history is complex. In addition to amount of use, it depends on phone type, network properties, conditions of use and

Interphone latest study 2011

Cardis E, Armstrong BK, Bowman JD et al. Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries. *Occup Environ Med* (2011); 68(9):631-640.

Odds Ratio for Brain Tumor (7+ years of cell phone use)



Stratified by Total Cumulative Energy Exposure (joules/kilogram)

From Table 3: Cardis E, Armstrong BK, Bowman JD et al. Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries. *Occup Environ Med* (2011); 68(9):631-640.

INTERPHONE Study 2011

Our results suggest that there may be an increase in risk of glioma in the most exposed area of the brain among long-term and heavy users of mobile phones. These results are uncertain (in light of the uncertainties associated with tumour centre localisation, radio frequency dose estimation and sample size) and require replication before they can be taken to indicate a cause eeffect relationship.

From the conclusions of the 2001 INTERPHONE study (industry-financed).

Study authors finally admitted that their data showed increase risk of glioma, but said that this finding required replication before being taken as a cause and effect relationship.

This despite the fact that this finding was already a replication of their previously published data, and had also been confirmed several times in the published data of the Hardell group in Sweden.

Danish Study 2011

BBC NEWS

HEALTH

20 October 2011 Last updated at 21:11 ET

Mobile phone brain cancer link rejected

By Nick Triggle
Health correspondent, BBC News

Further research has been published suggesting there is no link between mobile phones and brain cancer.

The risk mobiles present has been much debated over the past 20 years as use of the phones has soared.

Danish study: Proclaimed as evidence that cell phones are safe.

420, 095 subscribers in the cohort — who had subcriptions by 1994/95.

Exposure is judged by presence of a cell phone contract, no record of actual usage.

200,507 corporate users excluded — **and placed in the control group**.

2550 juveniles excluded — **and placed in the control group**.

Frei P, Poulsen AH, Johansen C, Olsen JH, Steding-Jessen M, Schuz J. Use of mobile phones and risk of brain tumours: update of Danish cohort study. *BMJ* (2011); 343(d6387).

Danish Study 2011

Danish study: Proclaimed as evidence that cell phones are safe.

420, 095 subscribers in the cohort — who had subcriptions by 1994/95. Exposure is judged by presence of a cell phone contract, no record of actual usage.
200,507 corporate users excluded — and placed in the control group.
2550 juveniles excluded — and placed in the control group.
Half the subjects in the 2009 Johansen et al study had less than two years of cell phone use.

Second publication: Schuz 2006
Only 61% of subscribers reported making or receiving at least 1 call a week in prior six months
All users who began subscription after 1995 were put in the "unexposed" reference population.

Third publication Shuz et al 2011
Same study group
Control group 2.9 million Danes

Fourth publication: Frei et all 2011 BMJ
~ 42% of initial cohort excluded (and placed in control group).
Also in the control group — the 85% of Danes that got a cell phone contract between 1995 and 2004.

"Number of subscription years" is used as a surrogate for actual hours of usage.
18-29 year old excluded

Cohort established by grants from Danish telcom companies. Sources of funding of the International Epidemiology Institute (Rockville, MD, USA) have never been declared.

In this study, the control group was contaminated with so many cell phone users that the results of the study were essentially meaningless. Two reviews stating this fact were published in the same issue of BMJ, along with the Frie study.

Frei P, Poulsen AH, Johansen C, Olsen JH, Steding-Jessen M, Schuz J. Use of mobile phones and risk of brain tumours: update of Danish cohort study. *BMJ* (2011); 343(d6387.

Philips A, Lamburn G. Updated study contains poor science and should be disregarded. *BMJ* (2011); 343(d7899; author reply d7912).

Soderqvist F, Carlberg M, Hardell L. Review of four publications on the Danish cohort study on mobile phone subscribers and risk of brain tumors. *Rev Environ Health* (2012); 27(1):51-58.

Studies from the Hardell Group in Sweden

INTERNATIONAL JOURNAL OF ONCOLOGY 38: 1465-1474, 2011

Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects

LENNART HARDELL[1], MICHAEL CARLBERG[1] and KJELL HANSSON MILD[2]

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[2]Department of Radiation Physics, Umeå University, SE-901 87 Umeå, Sweden

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DOI: 10.3892/ijo.2011.947

Abstract. We studied the association between use of mobile and cordless phones and malignant brain tumours. Pooled analysis was performed of two case-control studies on patients with malignant brain tumours diagnosed during 1997-2003 and matched controls alive at the time of study inclusion and one case-control study on deceased patients and controls diagnosed during the same time period. Cases and controls or relatives to deceased subjects were interviewed using a structured questionnaire. Replies were obtained for 1,251 (85%) cases and 2,438 (84%) controls. The risk increased with

emissions from wireless devices such as mobile phone base stations, broadcast transmission towers, pagers and personal digital assistants, wireless networks and other sources of RF radiation (1).

The brain is the target organ of the body with highest near field exposure to microwaves during use of a handheld wireless phone. Thus, fear of an increased risk for brain tumours from RF fields emitted from mobile phones has dominated the debate the last decade. Of equal importance is use of the desktop cordless phones

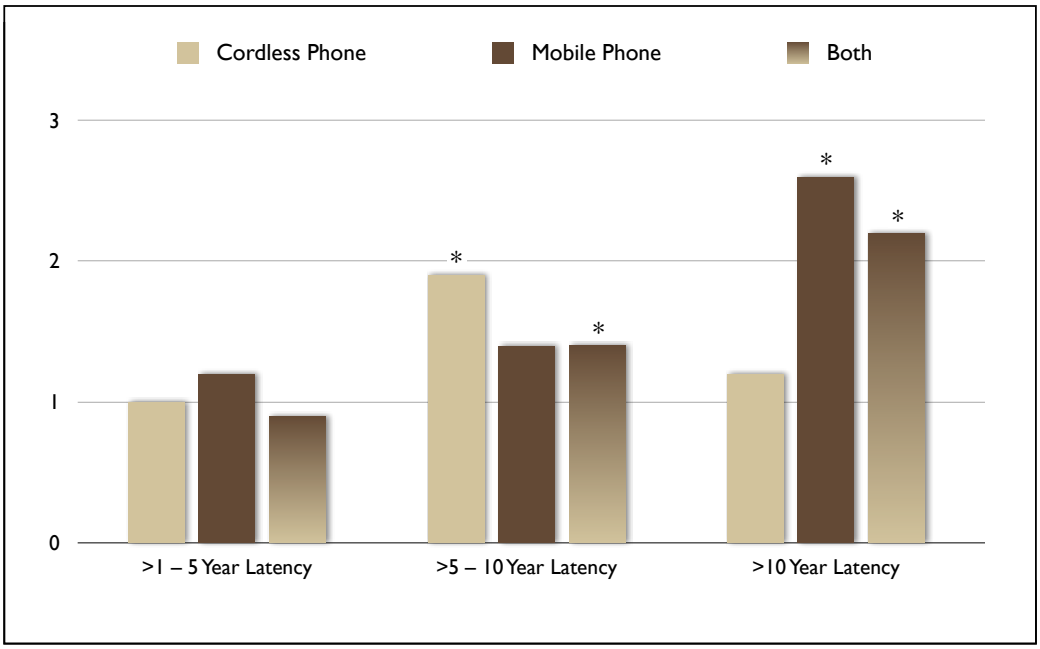
The most reliable research on the tumor risks of cell phones has been performed by the Hardell group in Sweden.

This group does not receive funding from the cell phone industry.

This is the only group that has controlled for use of in-home cordless phones as well as cell phones [which makes their data more reliable].

Hardell L, Carlberg M, Hansson Mild K. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. *Int J Oncol* (2011b); 38(5):1465-1474.

Tumor Risk by Years of Use – Glioma

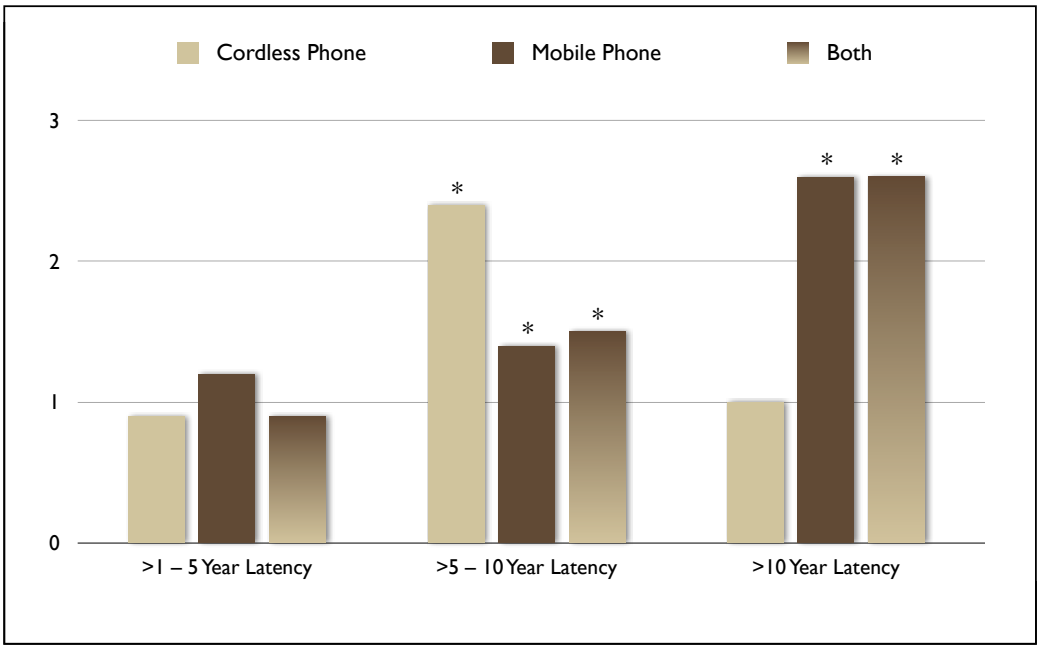


Orient to the bar graph.

Hardell group -- current summary

From Table IV: Hardell L, Carlberg M, Hansson Mild K. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. *Int J Oncol* (2011b); 38(5):1465-1474.

Tumor Risk by Years of Use – Astrocytoma



Hardell group -- current summary

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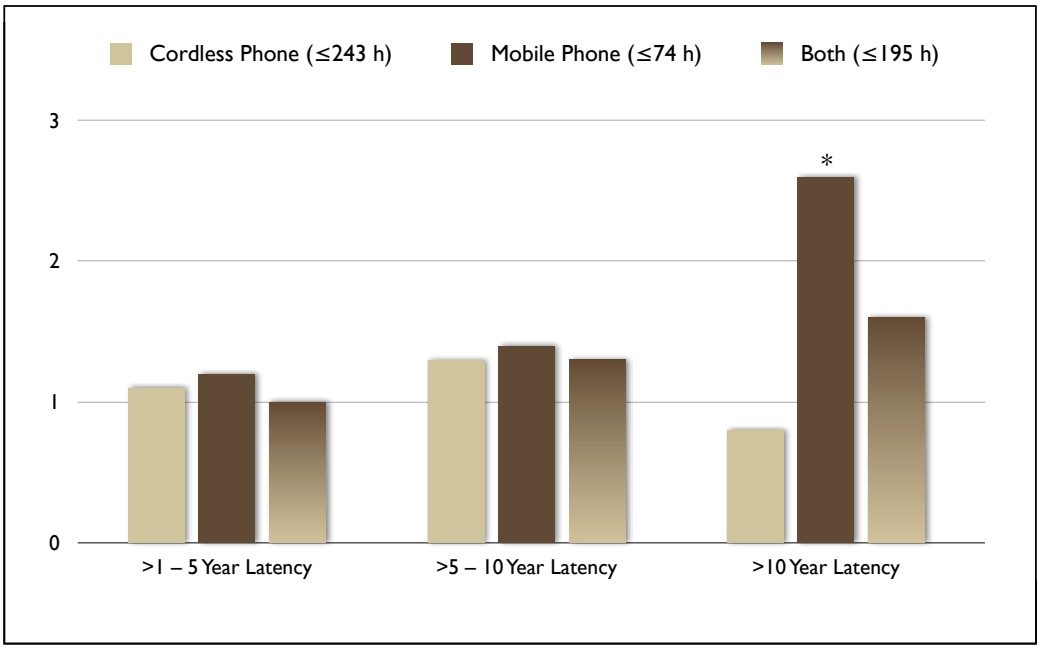
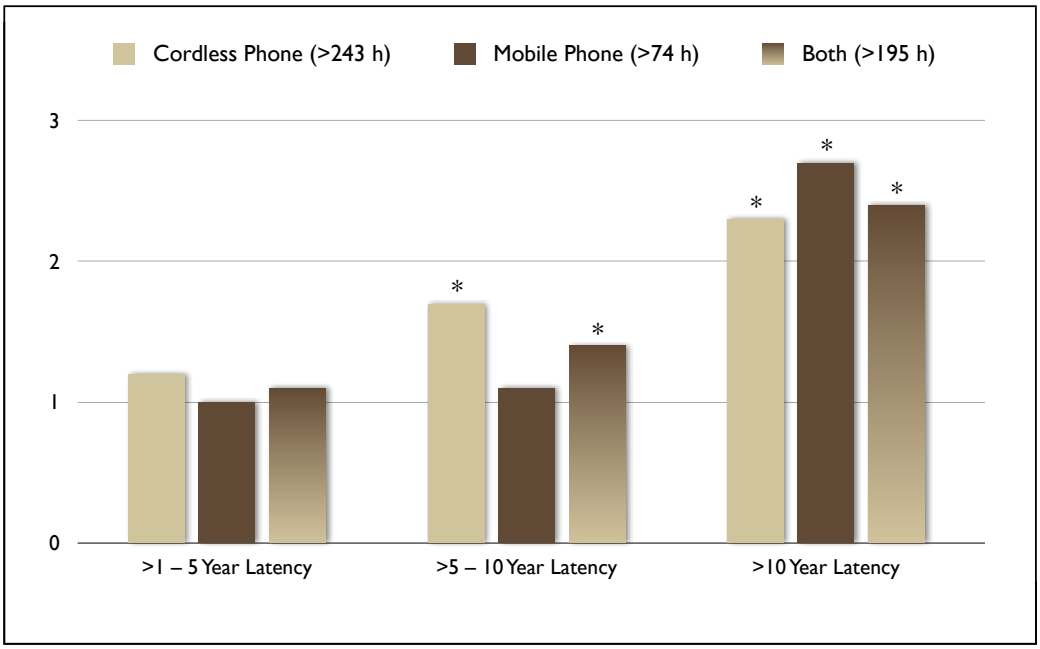
Risk of All Brain Tumors (Usage Below Median)



Hardell group –– current summary

From Table IV: Hardell L, Carlberg M, Hansson Mild K. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. *Int J Oncol* (2011b); 38(5):1465-1474.

Risk of All Brain Tumors (Usage Above Median)



Hardell group –– current summary

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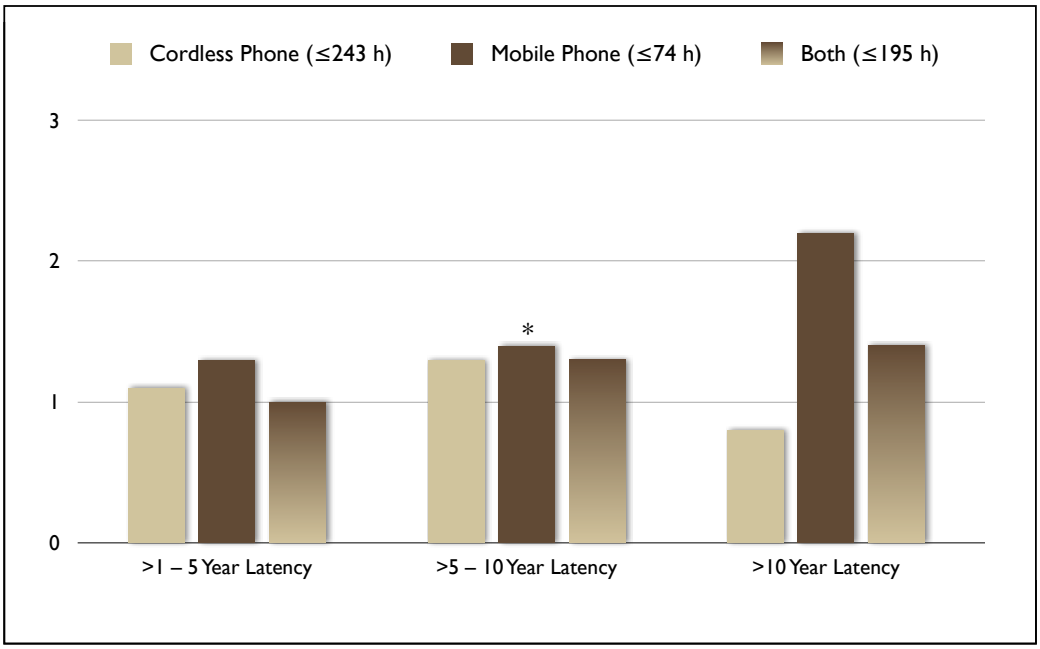
Risk of Glioma (Usage Below Median)



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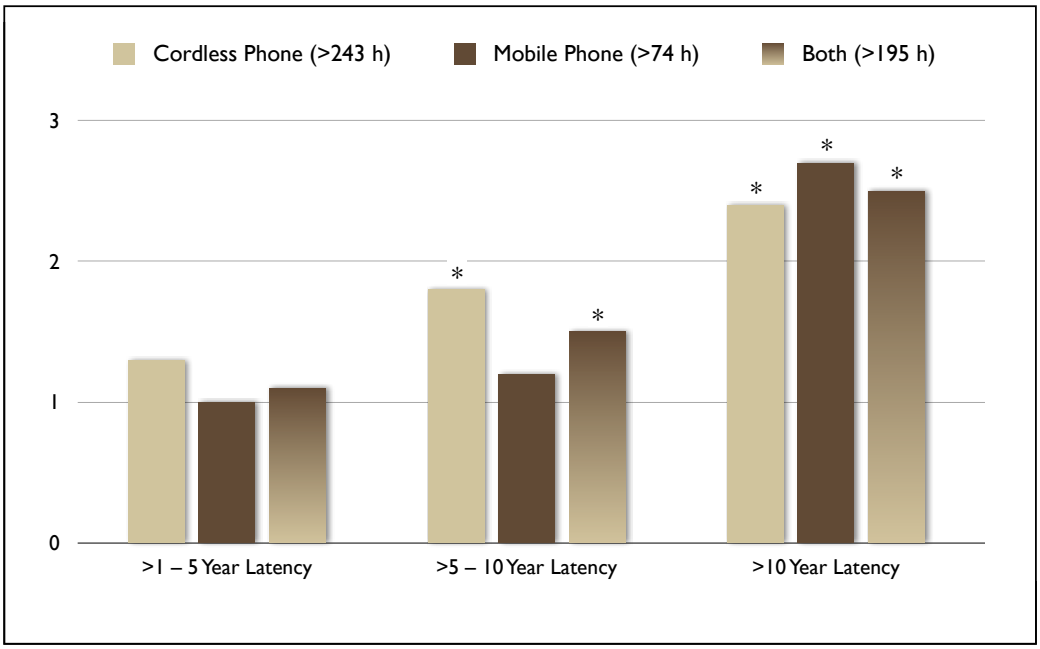
Risk of Glioma (Usage Above Median)



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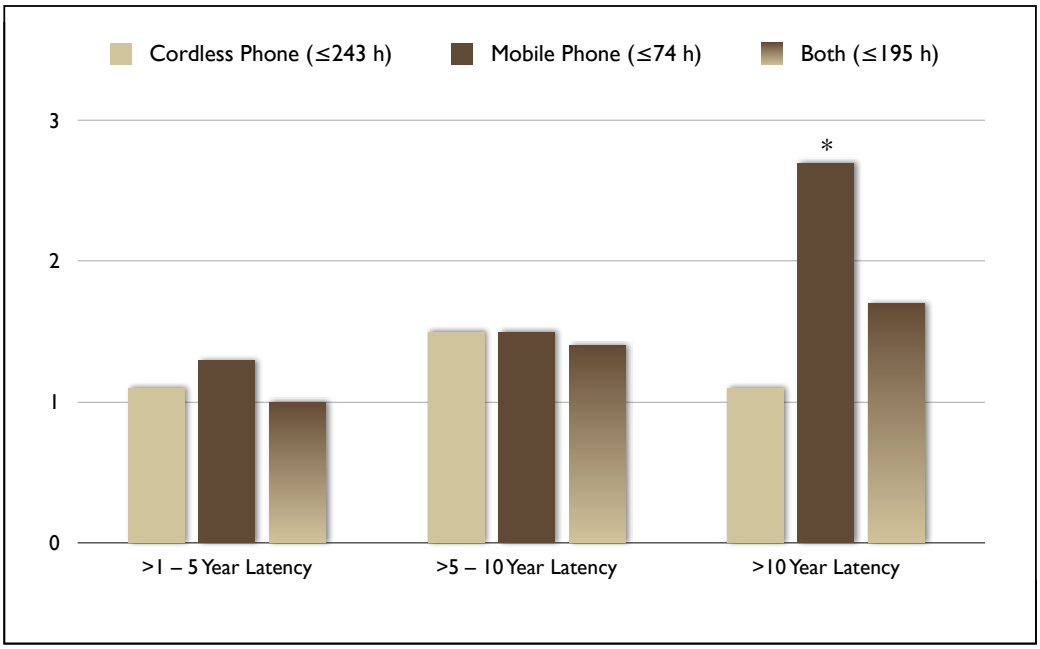
Risk of Astrocytoma (Usage Below Median)



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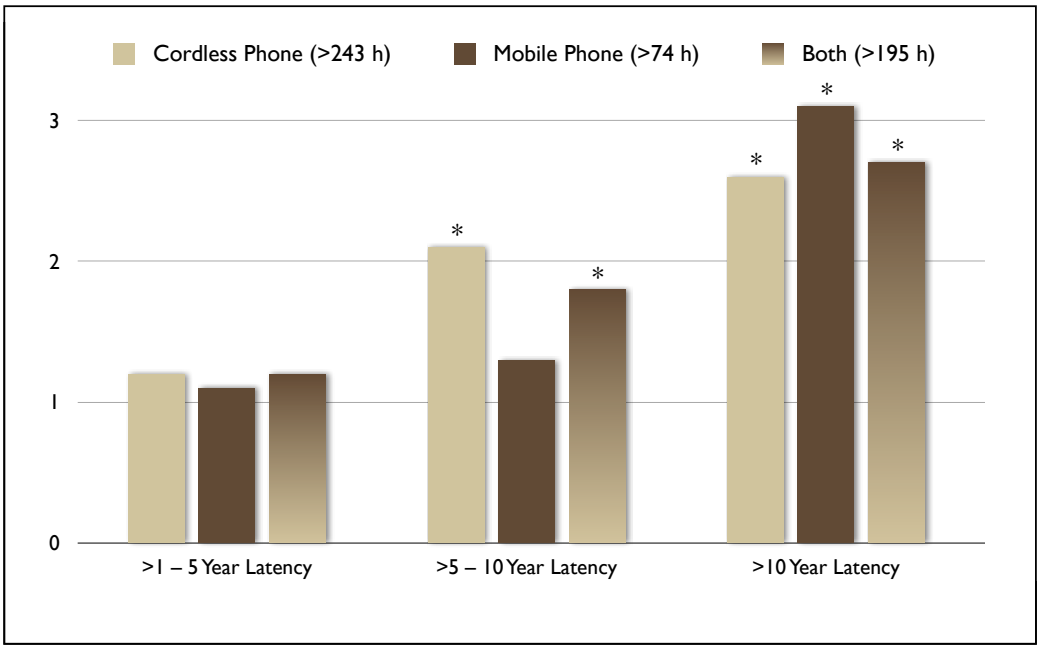
Risk of Astrocytoma (Usage Above Median)



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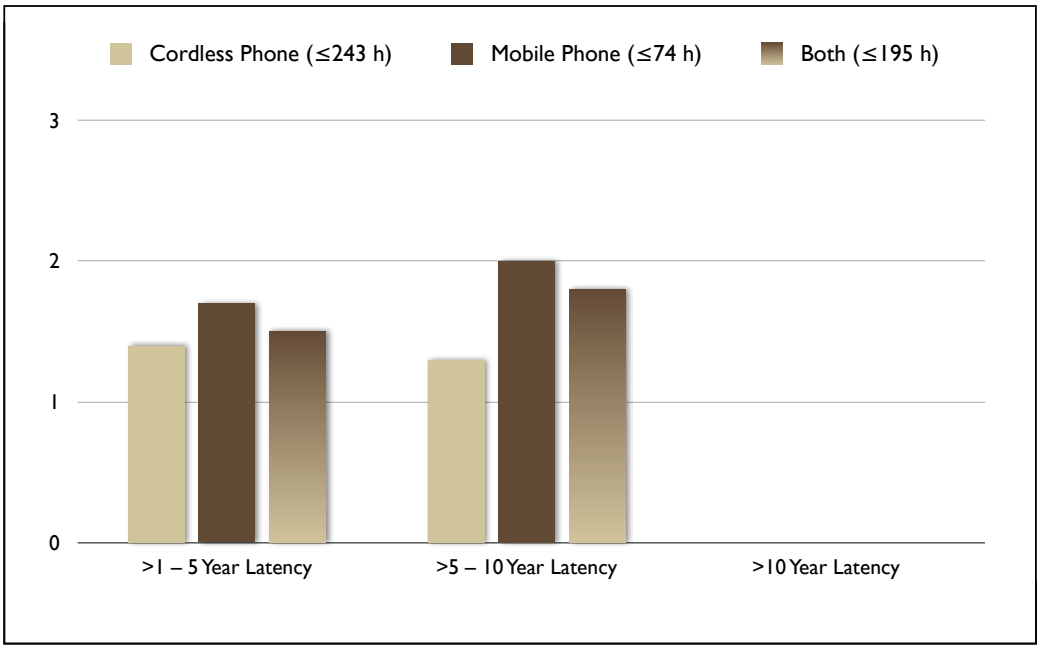
Risk of Oligodendroglioma (Usage Below Median)



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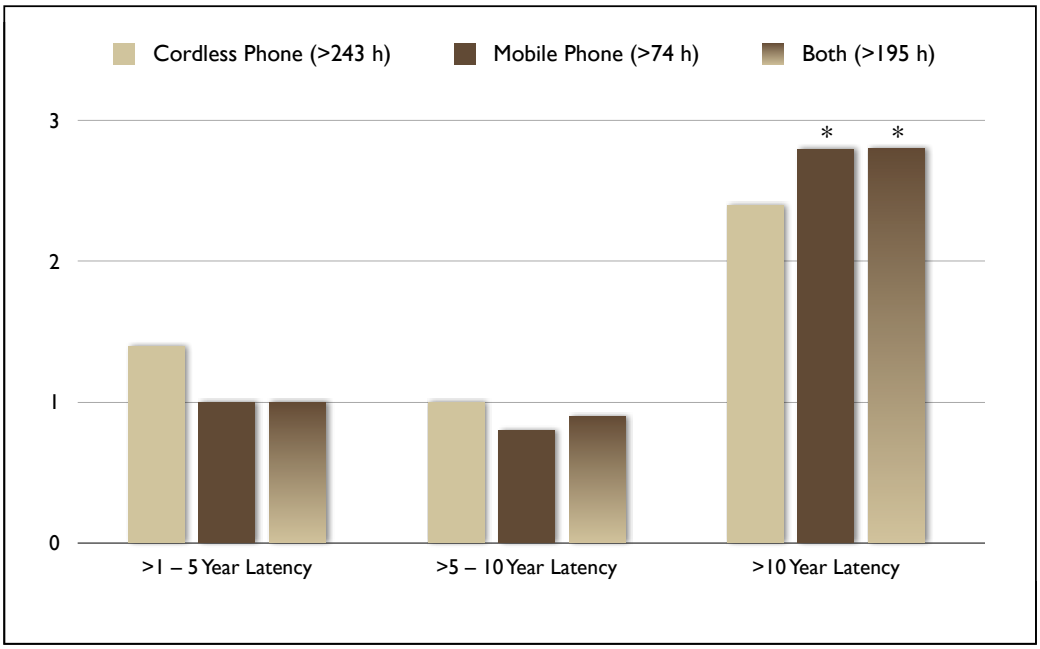
Risk of Oligodendroglioma (Usage Above Median)



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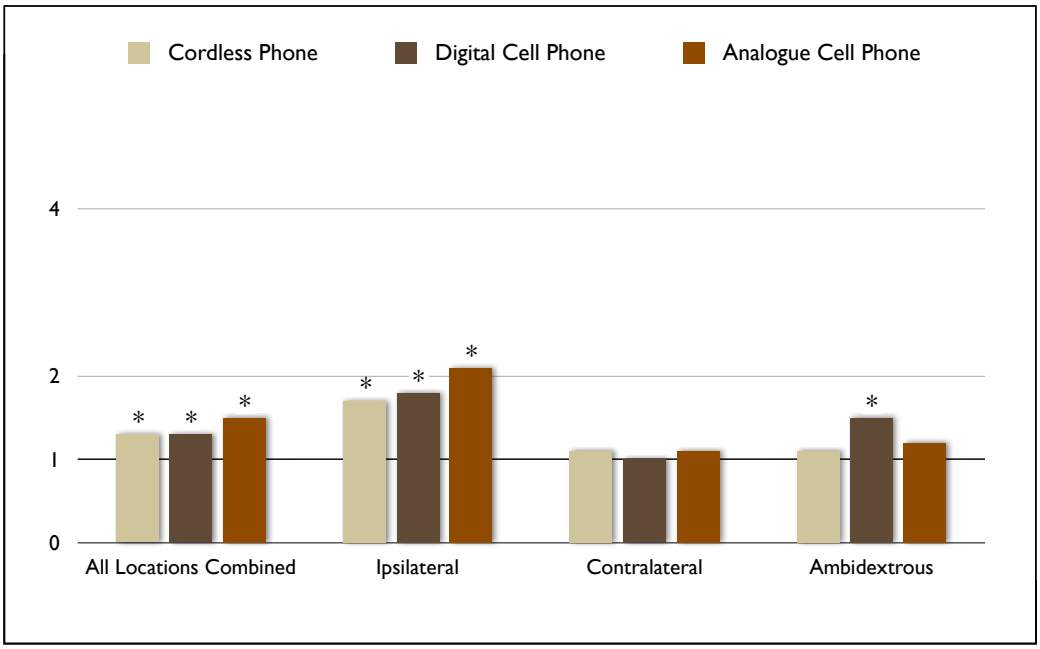
Risk of Tumor by Location – All Tumor Types



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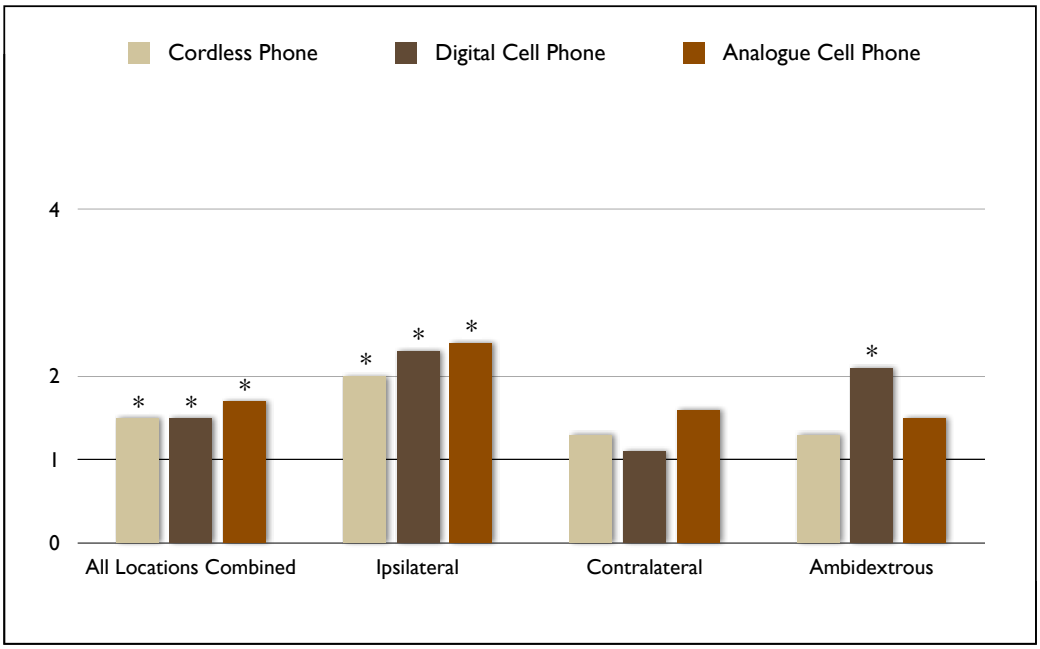
Risk of Tumor by Location – High Grade Astrocytoma



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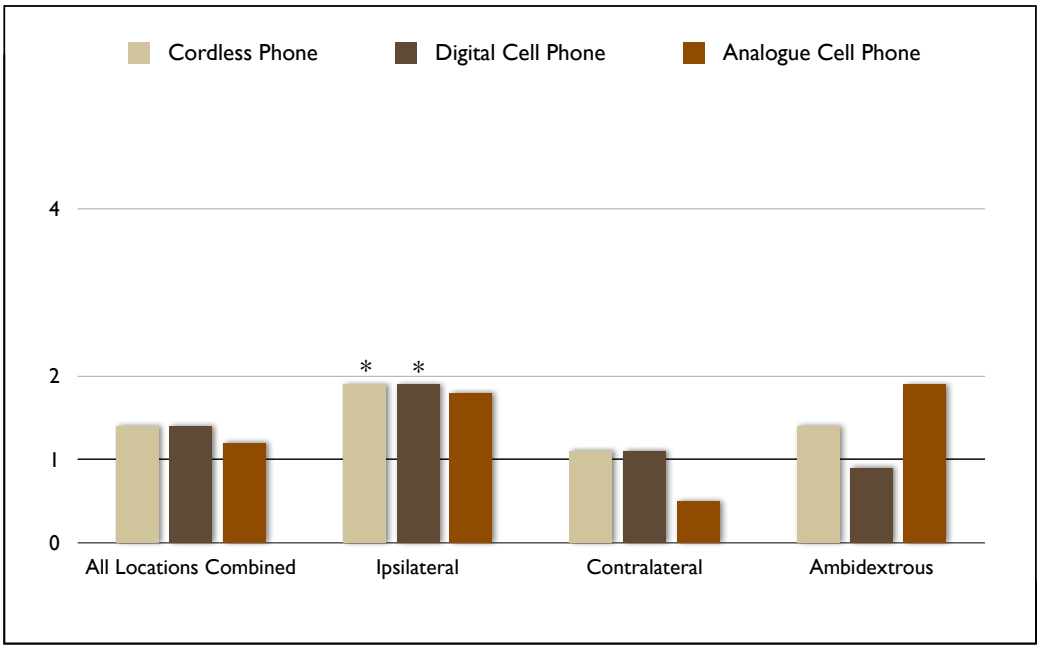
Risk of Tumor by Location – Low Grade Astrocytoma



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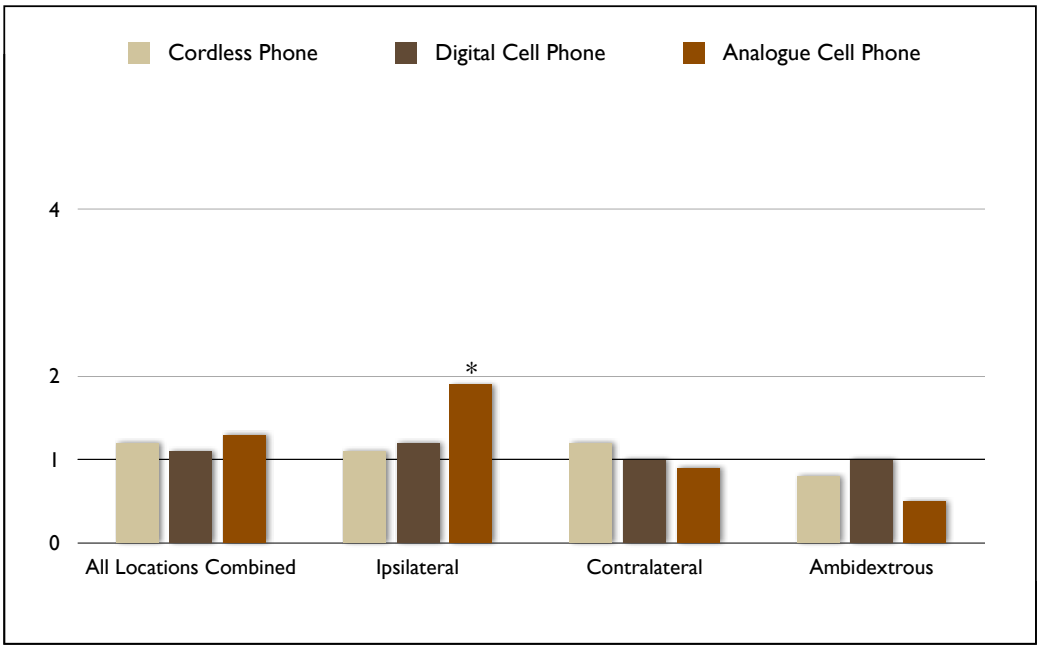
Risk of Tumor by Location – Other Malignant Tumors



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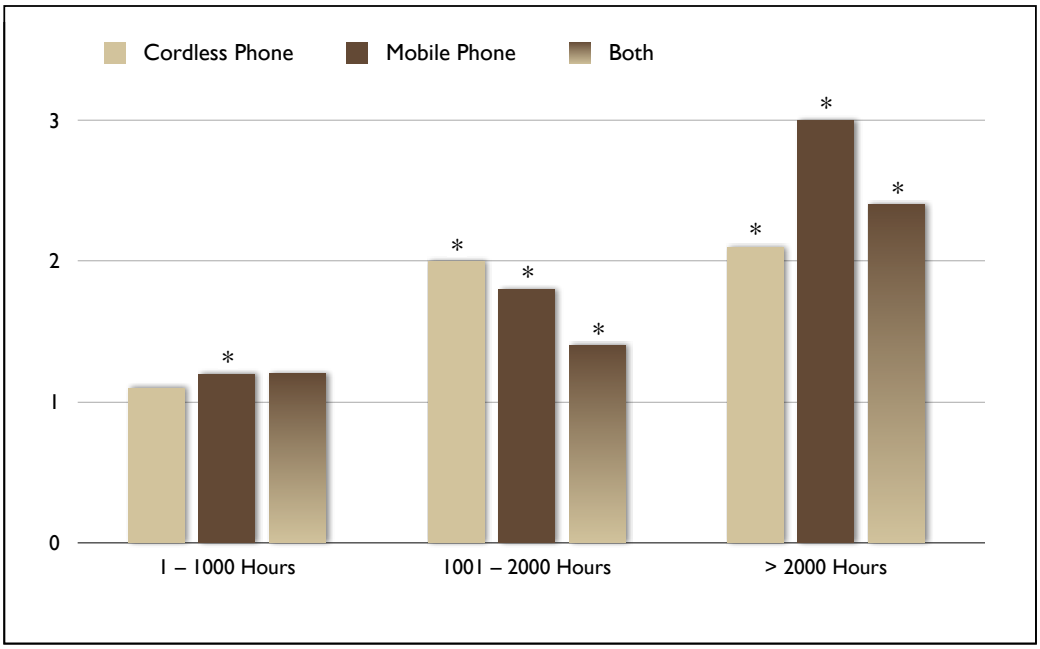
Tumor Risk by Cumulative Hours of Use – Any Brain Cancer



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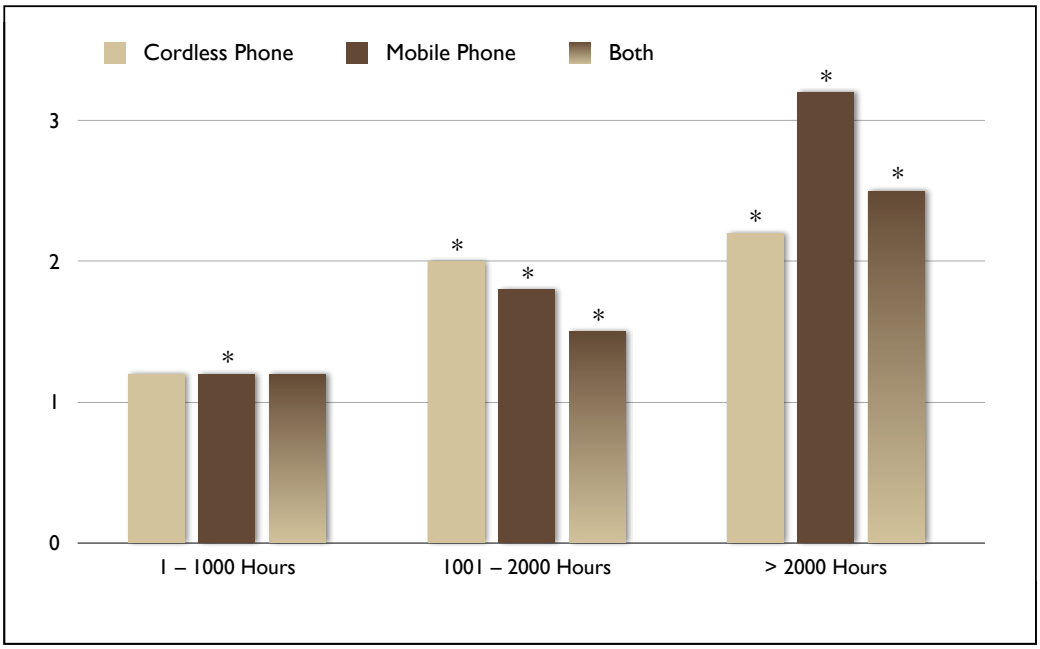
Tumor Risk by Cumulative Hours of Use – Glioma



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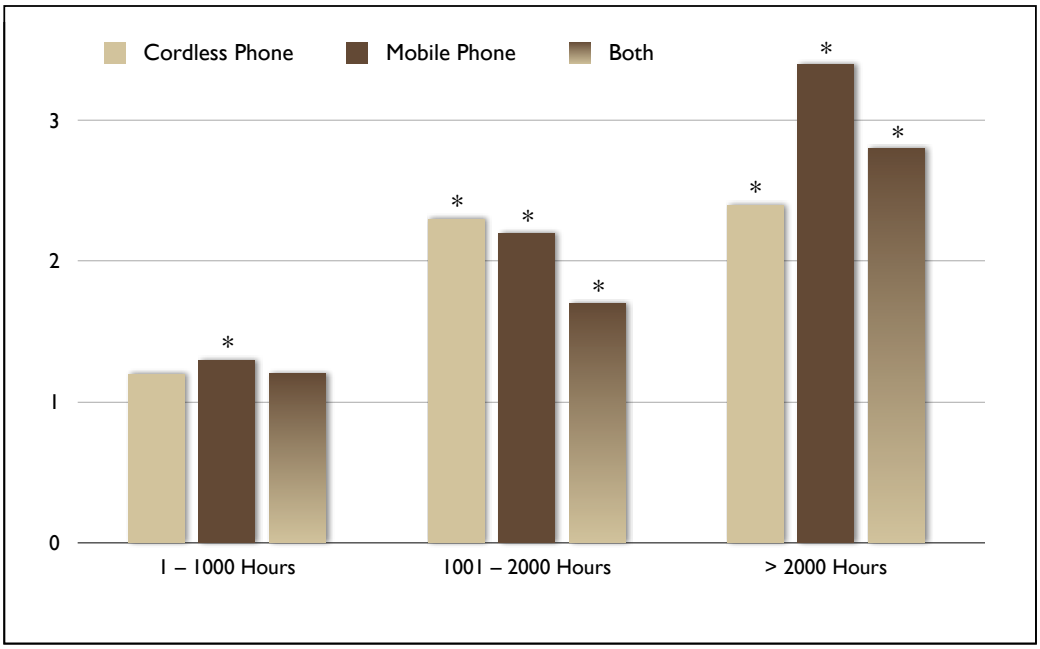
Tumor Risk by Cumulative Hours of Use – Astrocytoma



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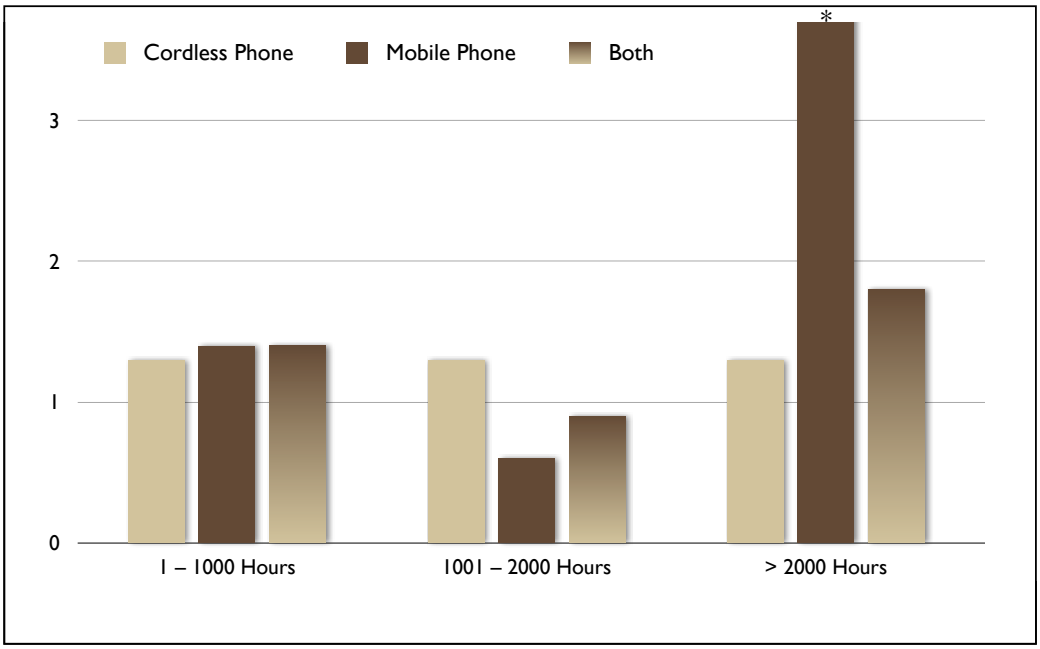
Tumor Risk by Cumulative Hours of Use – Oligodendroglioma



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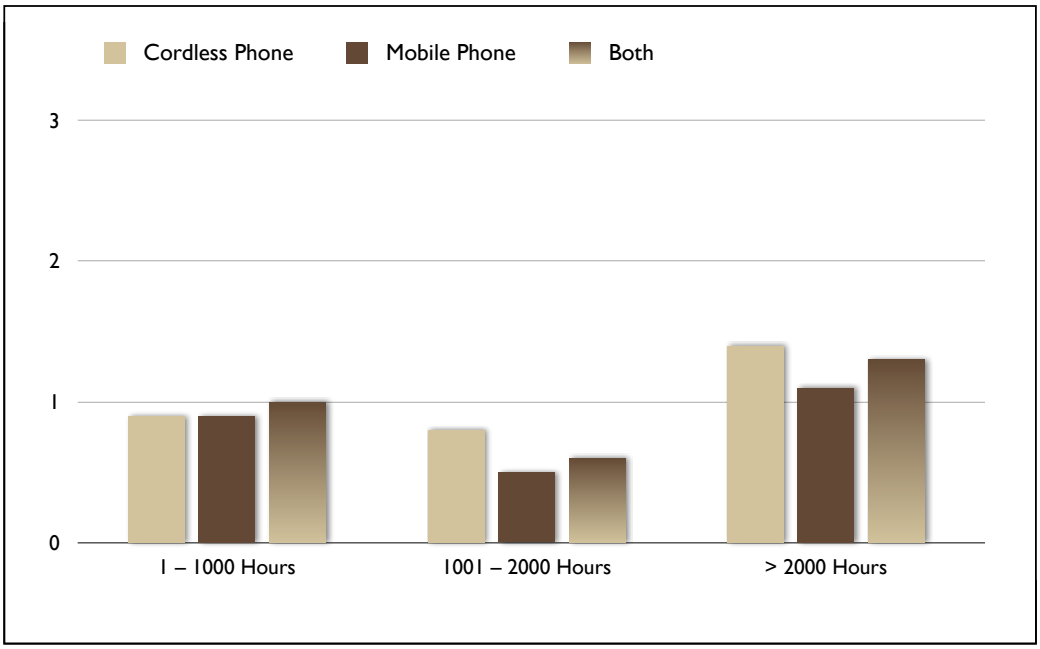
Tumor Risk by Cumulative Hours of Use – Other/Mixed Glioma



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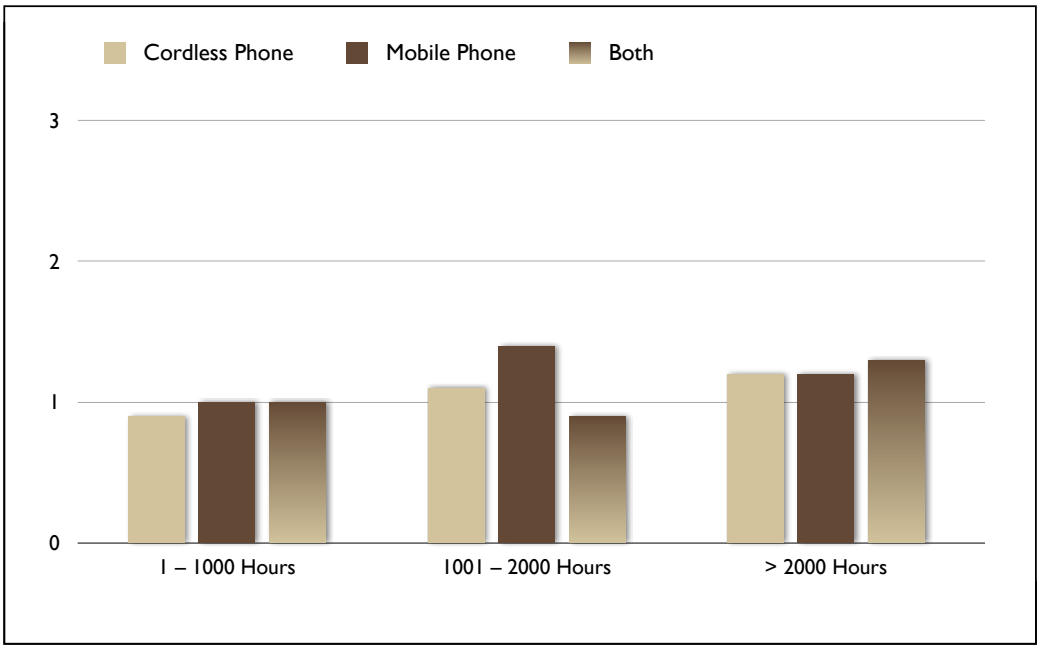
Tumor Risk by Cumulative Hours of Use – Other Brain Malignancy



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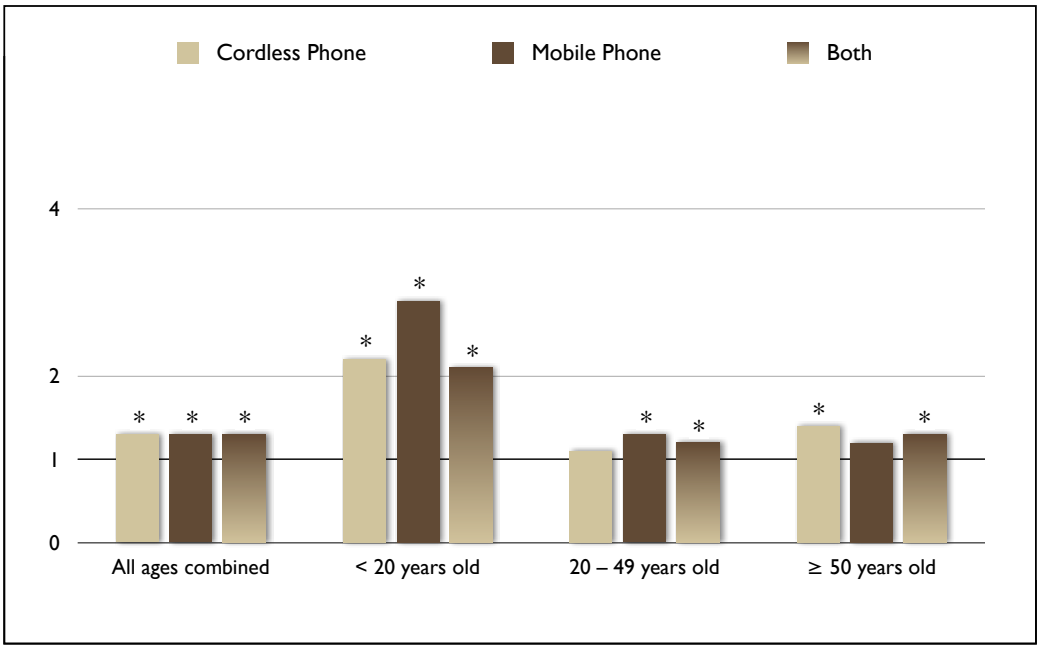
Tumor Risk by Age of First Use – Any Brain Cancer



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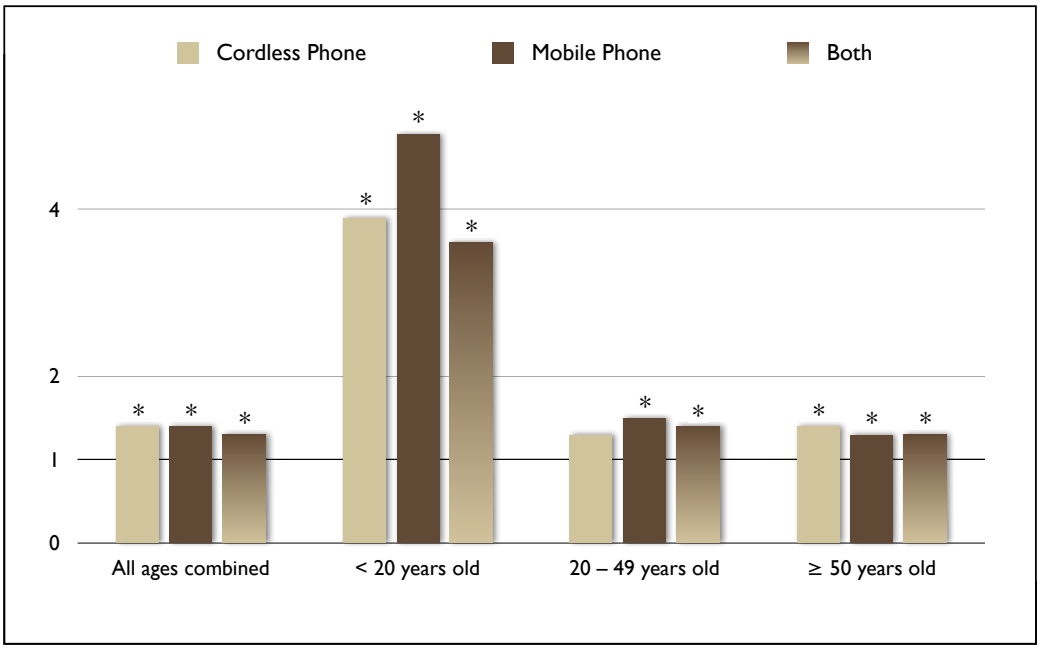
Tumor Risk by Age of First Use – Astrocytoma



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